relationships are expected to be shown in it. He believes "that no great progress in systematic petrography is possible until a more rational view of the relationship of that science to geology prevails among its devotees." The rock, in petrography, is a unit of material; while in geology it is a unit of form or mass. The geological rock is the subject of study in *petrology*. The classification of rocks in *petrography* should be a classification based on facts and not on theories; it should be based on the properties of the rocks themselves, and upon their relationships to one another and to the earth. No natural classification of rocks is possible, because of the nature of these bodies. "The systematic classification of rocks, according to which their specific names are applied, must be based on their properties as objects, together with only such geological criteria as may be found adaptable, to the end that the system may be uniform, stable, and as natural as possible." The author examines critically the accepted scheme of classification as now used, and shows that it is illogical, being based primarily on geological criteria that are largely theoretical. He objects also to the founding of the classification upon such hypothetical factors as those embraced in the theory of magmatic differentiation. On the other hand, "the material properties of igneous rocks afford ample criteria for establishing a systematic classification. . . . Since the geological factors of age, or of form, or place of occurrence, are not directly causes of the properties used in classification, they cannot be applied to produce coördinate groups."

Leucite Rocks from Montana. — In another paper Cross[1] reports the existence of a most interesting series of leucite rocks at the Leucite Hills and Pilot Butte, Wyoming. Some of these rocks have already been described by Zirkel, Emmons, and Kemp, but none of these geologists had learned of the great variety of types in the region. The principal area of leucite rocks is a mesa whose top consists of a surface flow of porous and massive rock material, the latter of which corresponds to Zirkel's leucitite, while the vesicular rock is a sanidine-leucite aggregate. The massive rock is redescribed by Cross as consisting of phlogopite crystals in a groundmass made up of leucite crystals and anhedra, separated from one another by pale green or colorless microlites of diopside, imbedded in a very siliceous glass. This rock the author calls *wyomingite*.

The principal rock of the Leucite Hills is the sanidine-leucite

[1] *Amer. Journ. Sci.*, vol. iv, p. 115, 1897.

aggregate referred to above. In addition to the two minerals mentioned, it contains also phlogopite, amphibole, and diopside. The phlogopite is in phenocrysts. The sanidine and the leucite are usually grouped in separate patches, the former in aggregates of stout, square prisms, associated with ophitic amphibole and with diopside, and the leucite in aggregates of minute anhedra, some of which are enclosed in amphibole prisms. The sanidine is filled with inclusions of diopside needles. The rock is called *orendite*. The amphibole of the orendite possesses very peculiar properties. While having a prismatic cleavage angle of 124°, its extinction appears always to be parallel to the *c* axis. Its pleochroism is $\mathfrak{a} = a$, pale yellow; $\mathfrak{b} = b$, red; $\mathfrak{c} = c$, bright yellow, and its axial figure is almost that of a uniaxial mineral.

The rock of Pilot Butte, a mesa separated from the Leucite Hills by a valley, is composed of colorless diopside, phlogopite, and, probably, perofskite, in a brown glassy base of the composition of leucite. This rock, which is probably a portion of a volcanic flow, is called *madupite*. The phlogopite of the madupite differs from that of the orendite in that it occurs as roundish grains filled with diopside microlites and perofskite grains. The cleavage is not as well marked as is usually the case in micas, but the optical properties are those of phlogopite.

The chemical composition of the three types of rocks is represented by the analyses following:

	Wyomingite	*Orendite*	*Madupite*
SiO_2	= 53.70	54.08	42.65
TiO_2	= 1.92	2.08	1.64
Al_2O_3	= 11.16	9.49	9.14
Fe_2O_3	= 3.10	3.19	5.13
FeO	= 1.21	1.03	1.07
CaO	= 3.46	3.55	12.36
BaO	= .62	.67	.89
MgO	= 6.44	6.74	10.89
K_2O	= 11.16	11.76	7.99
Na_2O	= 1.67	1.39	.90
H_2O at 110°	= .80	.79	2.04
H_2O above 110°	= 2.61	2.71	2.18
P_2O_5	= 1.75	1.35	1.52
Other constit.	= .80	1.14	1.71
Totals	100.40	99.97	100.11

The constituents included among the "other constituents" are ZrO_2, Ce_2O_3, Di_2O_3, Cr_2O_3, MnO, SrO, Li_2O, SO_3, Cl, Fl, and CO_2. The totals corrected for Fl are 100.21, 99.76, and 99.91.

The author points out the practical identity in the composition of the wyomingite and orendite, and concludes from this identity "that chemical composition of a magma does not alone determine whether leucite or sanidine shall be formed, but that this is controlled by conditions of consolidation."

A reclassification of leucite rocks is proposed, based on the quantitative importance of the leucite in them. The term leucitite is reserved for rocks in which leucite is the predominant component. Wyomingite and its granular equivalent are rocks in which leucite is of approximately equal importance with the ferro-magnesian-lime silicates. Orendite contains sanidine and leucite in about equal quantities. Both of these rocks are rich in silica. In madupite the heavy silicates predominate, leucite being in subordinate quantity. Its magma is low in silica.

Inclusions in the wyomingite and the orendite have been subjected to considerable contact action, the feldspars in the inclusions having suffered more than the bisilicates.